

US-PAT-NO: 6266442

DOCUMENT-IDENTIFIER: US 6266442 B1

TITLE: Method and apparatus for identifying
objects depicted in
a videostream

----- KWIC -----

Other Reference Publication - OREF (15):

A Real-Time Traffic Sign Recognition System, S. Estable,
J. Schick, F.
Stein, R. Janssen, R. Ott, W. Ritter, Y.-J. Zheng,
Daimler-Benz Research
Center, Proceedings of the Intelligent Vehicles '94
Symposium, Paris, France,
pp. 213-218, Oct. 1994.

Other Reference Publication - OREF (16):

Recognition of Traffic Signs by Artificial Neural
Network, D. Ghica, S. Lu,
X. Yuan, Dept. of Computer Science Memorial University of
Newfoundland, IEEE,
pp. 1444-1449, Mar. 1995.

Other Reference Publication - OREF (17):

Realtime Traffic Sign Recognition (TSR), Jens Logemann,
Ed., Univeritat
Koblenz-Landau, 3 pgs., Nov. 1997.



US006266442B1

(12) **United States Patent**
Laumeyer et al.

(10) Patent No.: **US 6,266,442 B1**
(45) Date of Patent: **Jul. 24, 2001**

(54) **METHOD AND APPARATUS FOR IDENTIFYING OBJECTS DEPICTED IN A VIDEOSTREAM**

(75) Inventors: **Robert Anthony Laumeyer**,
Minneapolis; **James Eugene Retterath**,
Excelsior, both of MN (US)

(73) Assignee: **Facet Technology Corp.**, Minneapolis,
MN (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/177,836**

(22) Filed: **Oct. 23, 1998**

(51) Int. Cl.⁷ **G06K 9/66**

(52) U.S. Cl. **382/190; 382/104**

(58) Field of Search **382/190, 163,**
382/164, 165, 104, 155, 159, 162, 166

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,392,365	*	2/1995	Steinkirchner	382/260
5,448,484		9/1995	Bullock et al.	
5,465,115	*	11/1995	Conrad et al.	348/155
5,465,308		11/1995	Hutcheson et al.	
5,627,915		5/1997	Rosser et al.	
5,633,944		5/1997	Guibert et al.	
5,633,946		5/1997	Lachinski et al.	
5,699,444		12/1997	Palm	
5,740,274		4/1998	Ono et al.	
5,790,691		8/1998	Narayanswamy et al.	
5,844,699	*	12/1998	Usami et al.	358/518
5,864,630		1/1999	Cosatto et al.	
5,974,521	*	10/1999	Akerib	712/11
5,991,085	*	11/1999	Rallison	359/630
6,064,768		5/2000	Hajj et al.	
6,141,433		10/2000	Moed et al.	

OTHER PUBLICATIONS

Dominant Color Transform and Circular Pattern Vector for
Traffic Sign Detection and Recognition, Jung Hak and Tae
Young Choi, IEICE Transaction Fundamentals, vol. E81-A,
No. 6, pp. 1128-1135, Jun. 1998.

(List continued on next page.)

Primary Examiner—Andrew W. Johns

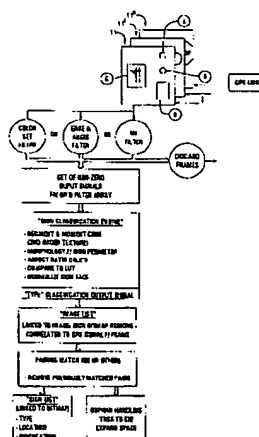
Assistant Examiner—Seyed Azarian

(74) *Attorney, Agent, or Firm*—Patterson, Thunte, Skaar &
Christensen, P.A.

(57) **ABSTRACT**

The present invention relates to an apparatus for rapidly
analyzing frame(s) of digitized video data which may
include objects of interest randomly distributed throughout
the video data and wherein said objects are susceptible to
detection, classification, and ultimately identification by
filtering said video data for certain differentiable character-
istics of said objects. The present invention may be practiced
on pre-existing sequences of image data or may be inte-
grated into an imaging device for real time, dynamic, object
identification, classification, logging/counting, cataloging,
retention (with links to stored bitmaps of said object),
retrieval, and the like. The present invention readily lends
itself to the problem of automatic and semi-automatic cata-
loging of vast numbers of objects such as traffic control signs
and utility poles disposed in myriad settings. When used in
conjunction with navigational or positional inputs, such as
GPS, an output from the inventive system indicates the
identity of each object, calculates object location, classifies
each object by type, extracts legible text appearing on a
surface of the object (if any), and stores a visual represen-
tation of the object in a form dictated by the end user/
operator of the system. The output lends itself to examina-
tion and extraction of scene detail which cannot practically
be successfully accomplished with just human viewers oper-
ating video equipment, although human intervention can
still be used to help judge and confirm a variety of classi-
fications of certain instances and for types of identified
objects.

6 Claims, 8 Drawing Sheets



OTHER PUBLICATIONS

- A Trainable Pedestrian Detection System*, C. Papageorgiou, T. Evgenious, T. Poggio, Center for Biological And Computational Learning and Artificial Intelligence Laboratory, MIT, IEEE International Conference on Intelligent Vehicles, pp. 241-246, 1998.
- Robust Lane Recognition Embedded in a Real-Time Driver Assistance System*, R. Risack, P. Klausmann, W. Krüger, W. Enkelmann, Fraunhofer-Institut für Informations, Karlsruhe, Germany, IEEE International Conference on Intelligent Vehicles, pp. 35-40, 1998.
- A Texture-based Object Detection and an Adaptive Model-based Classification*, T. Kalinke, C. Tzomakas, W. Seelen, Institut für Neuroinformatik, Bochum, Germany, IEEE International Conference on Intelligent Vehicles, pp. 143-148, 1998.
- Internet Printout: *The Road Sign Recognition System—RS²*, Faculty of Transportation Sciences, Prague, Czech Republic, 7 pgs., c. approximately 1999.
- Internet Printout: *The Chamfer System*, 4 pgs., c. approximately 1999.
- Real-Time Object Recognition: Hierarchical Image Matching in a Parallel Virtual Machine Environment*, J. You, P. Bhattacharya, S. Hungenahally, School of Computing and Information Technology, Griffith University, Brisbane, Australia, Dept. of Computer Engineering, University of Nebraska, Lincoln, Nebraska, 3 pgs., undated.
- An Architecture of Object Recognition System for Various Images Based on Multi-Agent*, Keiji Yanai, Koichiro Deguchi, Dept. of Computer Science, University of Electro-Communications, Tokyo, Japan, and Dept. of Mathematical Engineering and Information Physics, University of Tokyo, Tokyo, Japan, 4 pgs., undated.
- Multi-Feature Matching Algorithm for Free-Form 3D Surface Registration*, C. Schütz, T. Jost, H. Hügli, Institute for Microtechnology, Neuchatel, Switzerland, 3 pgs., undated.
- Representation of Uncertainty in Spatial Target Tracking*, Tim Baker, Malcolm Strens, DERA Farnborough, United Kingdom, 4 pgs., undated.
- Using Centroid Covariance in Target Recognition*, Gang Liu and Robert M. Haralick, Dept. of Electrical Engineering, University of Washington, Seattle, Washington, 4 pgs., undated.
- Using Spatial Sorting and Ranking in Model Based Object Recognition*, G. Hjaltason, M. Ray, H. Samet, I. Weiss, Computer Science Dept. University of Maryland, College Park, Maryland, 3 pgs., undated.
- Surveillance Systems for Terrestrial Transport Safety and Improved User Information Capability*, C. Nwagboso, C. Regazzoni, M. Renard, E. Stringa, Bolton Institute, Bolton, United Kingdom, Dept. of Biophysical & Electronic Engineering, Genova, Italy, Vigitec, Brussels, Belgium, pp. 1-7, undated.
- Landmark Recognition using Projection Learning for Mobile Robot Navigation*, Ren C. Luo, Harsh Potlapalli, Center for Robotics and Intelligent Machines, IEEE World Congress on Computational Intelligence, vol. IV, pp. 2703-2708, Jun. 1994.
- A Real-Time Traffic Sign Recognition System*, S. Estable, J. Schick, F. Stein, R. Janssen, R. Ott, W. Ritter, Y.-J. Zheng, Daimler-Benz Research Center, Proceedings of the Intelligent Vehicles '94 Symposium, Paris, France, pp. 213-218, Oct. 1994.
- Recognition of Traffic Signs by Artificial Neural Network*, D. Ghica, S. Lu, X. Yuan, Dept. of Computer Science Memorial University of Newfoundland, IEEE, pp. 1444-1449, Mar. 1995.
- Realtime Traffic Sign Recognition (TSR)*, Jens Logemann, Ed., Univeritat Koblenz-Landau, 3 pgs., Nov. 1997.
- Registering Multiple Cartographic Models with the Hierarchical Mixture of Experts Algorithm*, Simon Moss and Edwin R. Hancock, Dept. of Computer Science, University of New York, IEEE, pp. 909-914, 1997.
- Multi-Modal Tracking of Faces for Video Communications*, James L. Crowley and Francois Berard, GRAVIR-IMAG, I.N.P. Grenoble, Grenoble, France, IEEE, pp. 640-645, 1997.
- Road Traffic Sign Detection and Classification*, A. Escalera, L. Moreno, M. Salichs, J. Armingol, IEEE Transactions on Industrial Electronics, vol. 44, No. 6, pp. 848-859, Dec. 1997.
- Auto-associative Segmentation for Real-Time Object Recognition in Realistic Outdoor Images*, Leonardo Estevez and Nasser Kehtarnavaz, Dept. of Electrical Engineering, Texas A&M University, Journal of Electronic Imaging, vol. 72, pp. 378-385, Apr. 1998.
- Mandal, "Illumination Invariant Image Indexing Using Moments and Wavelets" *Journal of Electronic Imaging*, Apr. 1998 pp. 282-293, vol.7 (2), USA.
- Celentano, "Feature Integration and Relevance Feedback Analysis in Image Similarity Evaluation" *Journal of Electronic Imaging*, Apr. 1998, pp. 308-317 vol. 7(2), USA.
- Estevez, Auto-Associative Segmentation for Real-Time Object Recognition in Realistic Outdoor Images, Journal of Electronic Imaging, Apr., 1998 pp. 378-385 vol. 7(2), USA.

* cited by examiner